L4: Entry 13 of 74 File: JPAB Oct 17, 1995

PUB-NO: JP407265908A
DOCUMENT-IDENTIFIER: JP 07265908 A
TITLE: THIN CAST SLAB CONTAINING CU, SN AND PRODUCTION OF STEEL SHEET CONTAINING CU, SN

PUBN-DATE: October 17, 1995

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INT-CL (IPC): B21B 1/46; B22D 11/00; B22D 11/12; C22C 38/00; C22C 38/16

ABSTRACT:

PURPOSE: To provide a production method for a thin cast slab containing Cu and steel sheet capable of efficiently suppressing generation of surface flaw of the obtained product at low cost and eliminating rough rolling process in continuously casting a thin cast slab containing Cu, Su and subjecting to direct hot finish rolling without rough rolling on in-line of the continuous casting.

CONSTITUTION: In the case a thin slab of steel containing Cu of ≤75mm thickness, containing 0.05-0.5% Cu, ≤0.05% Sn is cast by continuous casting, when a cast slab is taken out while being supported in bent at the downward of mold, by setting a surface temp. of cast slab at the start point of supporting in bent to ≤1050°C and suppressing generation of surface flaw of cast slab due to Cu, Sn, a thin cast slab containing Cu, Sn is produced. Also, by setting a temp. of the obtained thin cast slab to ≤1050°C, subjecting to hot finish rolling and suppressing generation of surface flaw of steel sheet due to Cu, Sn, a steel sheet containing Cu, Sn is produced.

Cu .05-.5

(19)日本国特許庁（ＪＰ）　(12)**公開特許公報**（Ａ）　(11)特許出願公開番号

特開平7－265908

(43)公開日　平成７年(1995)10月17日

(51)Int.Cl.[6]		識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｂ２１Ｂ	1/46		Ｂ		
Ｂ２２Ｄ	11/00		Ａ		
	11/12		Ａ		
Ｃ２２Ｃ	38/00		３０１　Ｚ		
	38/16				

審査請求　未請求　請求項の数２　ＯＬ　（全７頁）

(21)出願番号　特願平6－63984

(22)出願日　平成６年(1994)３月31日

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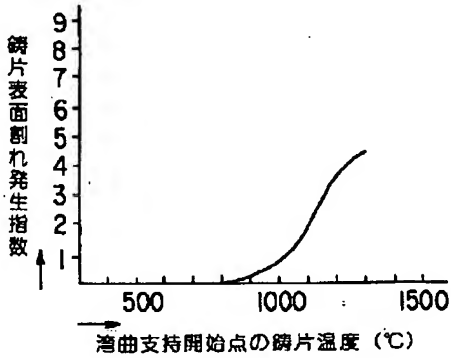
(54)【発明の名称】　Ｃｕ，Ｓｎ含有薄スラブ鋳片およびＣｕ，Ｓｎ含有鋼板の製造方法

(57)【要約】

【目的】　厚み７５㎜以下のＣｕ－Ｓｎ含有薄スラブ鋳片を連続鋳造し、この連続鋳造のインラインで粗圧延を経ないで直接熱間仕上げ圧延する場合に、得られる製品の表面疵の発生を安価でかつ効率的に抑制でき、粗圧延工程を省略できるＣｕ含有薄スラブ鋳片および鋼板の製造方法を提供する。

【構成】　Ｃｕ:0.05 ～0.5%，Ｓｎ:0.05%以下含有する厚みが７５㎜以下のＣｕ含有鋼の薄スラブを連続鋳造方法により鋳造するに際して、鋳型下方において、鋳造鋳片を湾曲支持して搬出する場合に、該湾曲支持の開始点における鋳片表面温度を１０５０℃以下にして、Ｃｕ，Ｓｎに起因する鋳片表面疵の発生を抑制し、Ｃｕ，Ｓｎ含有薄スラブ鋳片を製造する。又、得られた薄スラブ鋳片の温度を１０５０℃以下にし熱間仕上げ圧延してＣｕ，Ｓｎに起因する鋼板表面疵の発生を抑制し、Ｃｕ，Ｓｎ含有鋼板を製造する。



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【特許請求の範囲】

【請求項1】　Cu：0．05～0．5%，Sn：0．05%以下含有する厚みが75㎜以下のCu，Sn含有鋼の薄スラブを連続鋳造方法により鋳造するに際して、鋳型下方において、鋳造鋳片を湾曲支持して搬出する場合に、該湾曲支持の開始点における鋳片表面温度を1050℃以下に制御して、Cu，Snに起因する鋳片表面疵の発生を抑制することを特徴とするCu，Sn含有薄スラブ鋳片の製造方法。

【請求項2】　請求項1によって得られた薄スラブ鋳片を熱間仕上げ圧延して鋼板を製造するに際して、この仕上げ圧延機の入り側での鋳片表面温度を1050℃以下に制御してCu，Snに起因する鋼板表面疵の発生を抑制することを特徴とするCu，Sn含有鋼板の製造方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、Cu，Snに起因する表面疵の発生を抑制できるCu，Sn含有薄スラブ鋳片およびCu，Sn含有鋼板の製造方法に関するものである。

【0002】

【従来の技術】近年鉄鋼精練の分野では、鉄鋼原料としてスクラップが多量に使用される傾向にあり、自動車、家電、缶等のCu，Snを含有するスクラップを使用する機会が多くなってきている。鋼種によっては、Cu，Snを積極成分として含有させることもあるが、一般炭素鋼の場合、要求される特性を阻害する成分になることが多い。Cuの含有量が0．1%以上になると表面に小さな割れ疵が発生し、Cu含有量の増加に比例し、一層増加することは、誠文堂発行の『鉄鋼に及ぼす合金元素の影響』378頁の記載によっても知られている。

【0003】このCu，Snは精練によって除去することは困難であるため、このような鋼種を精練する場合には、Cu，Snを含有するスクラップとCu，Snを含有しないスクラップを混合して、Cu，Sn含有量を希釈するによって、これらの成分の影響を軽減する処理も行われている（『1990 Eliott Sympisium Proceedings』599頁参照）。

【0004】また、Cu含有鋼における上記の現象に対して、Cu含有鋼の精練に際してNiをCu含有量と同重量%添加し、表面疵の原因となる高温酸化時のCuの融液の鋼表面での析出を抑制することによって、表面割れの発生を防止することが提案されている。しかし、この方法では、資源に乏しく高価なNiを用いるために、コスト高になり、また、Cuの他にSnを含有する場合にはNiの添加による表面割れ発生防止効果が顕著には発現しない。

【0005】このようにして、精練して得られる鋼は、一般に連続鋳造によって鋳片とし、圧延して、製品化されるが、近年では、工程省略、熱損失の軽減等の観点から、図6に示すように、溶鋼aを連続鋳造機bによりスラブ鋳片cを連続鋳造し、インライン熱間粗圧延機dで粗圧延し、これに続く熱間仕上げ圧延機eで熱間仕上げ圧延して鋼板sを製造する連続鋳造インライン熱間圧延プロセスが採用されるようになってきた。

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【0006】このように、Cu，Suを含有する炭素鋼を精練し湾曲型、垂直曲げ型の連続鋳造機で連続鋳造してスラブ鋳片を製造した場合およびスラブ鋳片を連続鋳造のインラインで熱間圧延して鋼板を製造した場合等熱間加工を施して得られた製品においては、Cu含有量が0．2%未満であっても表面疵の発生が認められる。特に、鋳片の湾曲支持および粗圧延に際して、Cu脆化温度域で曲げ、圧延を施した場合に表面疵の発生が顕著であり、熱間仕上げ圧延機を経て得られる鋼板には表面疵が発生することが少なくない。

【0007】最近では双ドラム式連続鋳造、双ベルト式連続鋳造、単ベルト式連続鋳造等の特殊連続鋳造等の高速連続鋳造方法の開発が進んでおり、10～75㎜厚の薄鋳片を連続鋳造し、粗圧延工程を省略し、インライン熱間仕上げ圧延機で厚さ1．5㎜程度の鋼板を製造する試みがなされている。このようにして鋼板を熱間仕上げ圧延により製造する場合においても、前記の鋳片の湾曲支持に際して発生するCu，Snに起因する鋳片の表面割れは、熱間仕上げ圧延して得られる鋼板の致命的欠陥の発生につながるため、粗圧延工程省略した圧延プロセスのの実現の障害にもなっている。

【0008】

【発明が解決しようとする課題】本発明は、Cuを0．05～0．5%、Snを0．05%以下含有する厚み75㎜以下のCu，Sn含有薄スラブ鋳片を連続鋳造し、粗圧延を経ないで熱間仕上げ圧延する場合に，得られる製品の表面疵の発生を安価でかつ効率的に抑制でき、粗圧延工程を省略できる、Cu，Sn含有薄スラブ鋳片および鋼板の製造方法を提供するものである。

【0009】

【課題を解決するための手段】本発明の第一の発明は、Cu：0．05～0．5%，Sn：0．05%以下含有する厚みが75㎜以下のCu，Sn含有鋼の薄スラブ鋳片を連続鋳造方法により鋳造するに際して、鋳型下方において、鋳造鋳片を湾曲支持して搬出する場合に、該湾曲支持の開始点における鋳片表面温度を1050℃以下にして，Cu，Snに起因する鋳片表面疵の発生を抑制することを特徴とするCu，Sn含有薄スラブ鋳片の製造方法、また第二の発明は、請求項1によって得られた薄スラブ鋳片を熱間仕上げ圧延して鋼板を製造するに際して、この仕上げ圧延機の入り側での鋳片表面温度を1050℃以下にしてCu，Snに起因する鋼板表面疵の発生を抑制することを特徴とするCu，Sn含有鋼板の製造方法である。

【0010】

【作用】本発明においては、Cuを0．05～0．5%、Snを0．05%以下含有するCu，Sn含有鋼を熱間加工（連続鋳造、熱間圧延）する場合に、熱間加工時の温度を所定の温度に制御することにより、得られる製品の表面疵の発生を安価でかつ効率的に抑制でき、品質の良好なCu含有薄スラブ鋳片及び鋼板を製造することができる。

【0011】本発明者等は、Cuを0．1～0．3%、Snを0．05%以下含有するCu，Sn含有鋼を湾曲型、垂直曲げ型の連続鋳造して鋳片を製造した場合に鋳片表面割れが発生することから、その現象解明のため、割れが発生している鋳片の組織を観察した。その結果は図1に示す通りで、鋳片cの凝固組織内に金属Cu，Snが旧オーステナイト粒界gに侵入し、割れhを発生、成長させている。ここでSnが含有しているとCuは融液化しやすく、Snを含有しない場合に比し、前記オーステナイト粒界への侵入現象が顕著になる。そして、この割れは、鋳片の湾曲支持開始点近傍における鋳造半径が10m以下である場合に顕著に発生すること等が判明した。

【0012】このようなことから、Snを含有する場合の金属Cuの融点を確認し、この融点に対する鋳片の湾曲支持開始点における鋳片表面温度と鋳片の表面割れ発生との関係を調べた。その結果は図2に示す通りで、鋳片湾曲支持開始点の温度が1050℃以下で表面割れ発生指数を安定的に低下できることを確認できた。ただし、この温度が、低くなり過ぎると鋳片を最適な曲率で湾曲支持することができず、円滑な鋳造操業ができなくなるとともに、この鋳片を適温で熱間圧延することは困難になる。これらのことを考慮すると、この温度の下限値は800℃程度以下にすることは好ましくない。

【0013】このようにして、鋳造時鋳片の表面割れの発生を抑制することができる。しかし、このようにしてCuに起因する表面割れを抑制した鋳片を熱間圧延する場合、Cuが再融解するような温度領域で加工（圧延）を施す場合も、割れが発生する恐れがあるため、鋳片の熱間圧延機において、圧延温度と圧延後の鋼板の表面疵発生との関係も併せて調べた。その結果は、図3の通りで、熱間圧延機の入り側での鋳片表面温度が1050℃以下で表面割れ発生を安定的に抑制できることを確認できた。ただし、この温度が、低くなりすぎると鋳片を適温で熱間圧延することは困難になる。これらのことを考慮するとこの鋳片温度の下限値は、800℃程度以下にすることは好ましくない。以下に本発明をその実施装置例とともに説明する。

【0014】

【実施例】この実施例は、転炉で精錬して得られた、Cu：0．2%，Sn：0．05%を含有する溶鋼を双ベルト式連続鋳造機（湾曲型）で連続鋳造して、厚みが50～75㎜の薄スラブ鋳片を製造し、この薄スラブ鋳片を連続鋳造のインラインで熱間仕上げ圧延機で熱間仕上げ圧延して、厚み1．5㎜の鋼板を製造した場合のものである。

【0015】図4は、この実施例における装置配置の概要を示す説明図である。同図において、1は溶鋼鍋、2は溶鋼、3はタンディッシュ、4は浸漬ノズル、5は鋳型で、冷却構造を備えた無端状に移動する一対のベルト6，7とこの一対のベルトの両側端内面に接し無端状に移動する冷却構造を備えた一対の移動ブロック8，9によって構成されている。10は溶鋼2を鋳型5で冷却して得られる薄スラブ鋳片、11は薄スラブ鋳片を湾曲支持し、搬出する支持ロール、12は薄スラブ鋳片の湾曲支持開始点の温度を測定する温度測定装置である。また、13は保熱炉、14はインライン熱間仕上げ圧延機、15は熱間圧延して得られる鋼板、16は熱間圧延機入り側での薄スラブ鋳片の温度を測定する温度計で、17は搬送ロールである。

【0016】このように構成された連続鋳造機の鋳型に、溶鋼を注入しこれを冷却して凝固させ厚み50～75㎜の薄スラブ鋳片を鋳造し、この薄スラブ鋳片を連続鋳造インラインの熱間仕上げ圧延機により、熱間圧延して厚み1．5㎜の鋼板を製造した。この実施例における鋳型から出たの鋳片の各過程での表面温度変化を、前記従来例（図6の例）の場合とともに図5に示す。

【0017】なおこの実施例における鋳造条件、圧延条件は下記の通りである。

『鋳造条件』

鋳造鋼種：低炭素鋼で成分組成は表1に示す。

薄スラブ鋳片サイズ：厚み50～75㎜，幅1300㎜

鋳造速度：5m/min

基本鋳造半径：10m

湾曲支持開始点：メニスカスから3500㎜の位置

『圧延条件』

鋼板（製品）サイズ：厚み1．5㎜，幅1300㎜

【0018】本発明のこの実施例では、上記鋳造条件で薄スラブ鋳片を連続鋳造する際、鋳型からの鋳片の薄スラブ鋳片の湾曲支持開始点における表面温度を1050℃以下にし、この薄スラブ鋳片の熱間仕上げ圧延機の入り側での表面温度を1050℃以下にして熱間仕上げ圧延して鋼板を製造した。その結果を本発明の範囲外の比較例、従来例の場合とともに表2に示す。

【0019】

【表1】

	C	Si	Mn	Cu	Sn	P	S	Fe不純物
低炭素鋼	0.05	0.01	0.03	0.20	0.05	0.01	0.008	残り

【0020】　　＊　＊【表2】

No.	鋳片厚(mm)	湾曲支持開始点の鋳片温度(℃)	鋳造後の鋳片割れ	粗圧延機入側鋳片温度(℃)	粗圧延後の鋳片割れ	仕上圧延機入側鋳片温度(℃)	仕上圧延後の鋳片割れ
1	75	900	無	－	－	1000	無
2	50	950	〃	－	－	970	〃
3	75	900	〃	－	－	1080	有
4	50	1100	有	－	－	1020	〃
5	50	1200	〃	－	－	1100	〃
6	250	1250	〃	1240	有	1100	〃
7	75	－	無	－	－	1000	無
8	50	－	〃	－	－	1200	有
9	50	－	有	－	－	1000	〃
10	75	－	〃	－	－	1230	〃

【0021】この表2によって明らかなように、本発明の範囲である例1～2においては、鋳造して得られた薄スラブ鋳片、熱間仕上げ圧延して得られた鋼板ともに、品質に影響を与えるような表面割れの発生は認められなかった。しかし、例3では、湾曲支持開始点の温度を1050℃以下にして鋳造して表面割れのない薄スラブ鋳片を得たが、これを熱間仕上げ圧延機入り側の薄スラブ鋳片の表面温度を1050℃以上にして熱間圧延して得られた鋼板には、品質を低下させる顕著な割れ発生が認められた（表面割れのない薄鋳片でも熱間仕上げ圧延機の入り側の温度を1050℃以上にして圧延すると得られる鋼板に割れ発生がある。）。

【0022】また、例4では、湾曲支持開始点の温度を1050℃以上にして鋳造して表面割れのある薄スラブ鋳片をそのまま、熱間仕上げ圧延機入り側の薄スラブ鋳片の表面温度を1050℃以下にして熱間仕上げ圧延しているが、得られた鋼板には、品質を低下させる顕著な割れ発生が認められた（表面割れのある薄鋳片では熱間仕上げ圧延機の入り側の表面温度を1050℃以下にして圧延しても得られる鋼板に割れ発生がある。）。さらに、例5では、湾曲支持開始点の温度を1050℃以上にして鋳造して得られた表面割れのある薄スラブ鋳片をそのまま、熱間仕上げ圧延機入り側の表面温度を1050℃以上にして熱間仕上げ圧延しているが、得られた鋼板には、当然のことながら品質を低下させる顕著な割れ※※発生が認められた。

【0023】そして、従来例6では、厚手のスラブ鋳片を、湾曲支持開始点の温度を1050℃以上にして鋳造し、表面割れのあるスラブ鋳片をそのまま熱間粗圧延機、熱間仕上げ圧延機で圧延して鋼板を製造したものであり各熱間圧延機入り側の温度をいずれも1050℃以上にしたもので、得られた鋼板には、割れ発生が認められた。例7は連続鋳造で割れのない薄スラブ鋳片を製造し、別ラインで加熱炉で再加熱して仕上げ圧延した場合のもので、仕上げ圧延機入り側での薄スラブ鋳片の温度を1050℃以下にして圧延したところ、割れ発生は認められなかった。

【0024】例8は、連続鋳造で割れのない薄スラブ鋳片を製造し、別ラインで加熱炉で再加熱して仕上げ圧延した場合のもので、仕上げ圧延機入り側での薄スラブ鋳片の温度を1050℃以上にして圧延したところ、割れ発生が認められた。例9は、連続鋳造で割れのある薄スラブ鋳片を製造し、別ラインで加熱炉で再加熱して仕上げ圧延した場合のもので、仕上げ圧延機入り側での薄スラブ鋳片の温度を1050℃以下にして圧延しても、割れ発生が認められた。

【0025】例10は、連続鋳造で割れのある薄スラブ鋳片を製造し、別ラインで加熱炉で再加熱して仕上げ圧延した場合のもので、仕上げ圧延機入り側での薄スラブ鋳片の温度を1050℃以上にして圧延したところ割れ

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発生が認められた。なお厚みが７５㎜以上のスラブ鋳片の場合では、粗圧延を経ないで厚み１．５㎜レベルの鋼板を熱間仕上げ圧延して得ることは難しい。

【００２６】以上述べたように、Ｃｕ，Ｓｎを含有した鋼を湾曲型、垂直曲げ型の連続鋳造機で厚み７５㎜以下の薄スラブ鋳片を鋳造する場合、湾曲支持開始点の薄スラブ鋳片の温度を１０５０℃以下にすることにより、割れ発生のない品質良好な薄スラブ鋳片を安定的に得ることができる。またこのようにして得られた割れ発生のない薄スラブ鋳片を熱間仕上げ圧延して厚みが１．５㎜レベルまでの鋼板を製造する場合、熱間仕上げ圧延機の入り側での薄スラブ鋳片の温度を１０５０℃以下にすることにより、割れ発生のない品質の良好な鋼板を安定的に得ることができる。なお、上記実施例では本発明を連続鋳造インライン熱間仕上げ圧延プロセスで採用しているが、薄スラブ鋳片の連続鋳造と熱間仕上げ圧延を独立に実施する場合にも本発明を採用することができる。

【００２７】

【発明の効果】本発明においては、Ｃｕを０．０５～０．５％、Ｓｎを０．０５％以下含有する厚み７５㎜以下のＣｕ含有薄スラブ鋳片を連続鋳造し、圧延時、粗圧延を経ないで直接熱間仕上げ圧延する場合に、得られる製品の表面疵の発生を安価でかつ効率的に抑制でき、品質の良好なＣｕ含有薄スラブ鋳片及び鋼板を製造することができる。

【図面の簡単な説明】

【図１】割れ発生鋳片の凝固組織説明図。

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【図２】湾曲支持開始点の鋳片表面温度と鋳片割れ発生との関係説明図。

【図３】仕上げ圧延機入り側での鋳片温度と鋼板割れ発生との関係説明図。

【図４】本発明の実施例における連続鋳造とインライン熱間仕上げ圧延プロセスの設備配置例を示す側断面概要説明図。

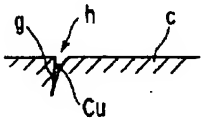
【図５】本発明の実施例における連続鋳造とインライン熱間仕上げ圧延プロセスでの鋳片表面温度の経時変化を示す説明図。

【図６】従来の連続鋳造とインライン熱間圧延プロセスの設備配置例を示す側断面概要説明図。

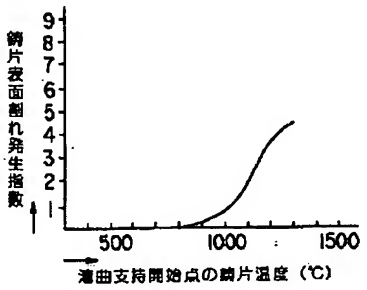
【符号の説明】

１：溶鋼鍋
２：溶鋼
３：タンディッシュ
４：浸漬ノズル
５：鋳型
６，７：ベルト
８（９）：移動短辺
１０：薄スラブ鋳片
１１：支持ロール
１２：温度測定装置
１３：保熱炉
１４：熱間仕上げ圧延機
１５：鋼板
１６：温度測定装置

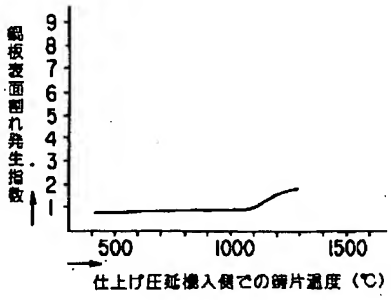
【図１】



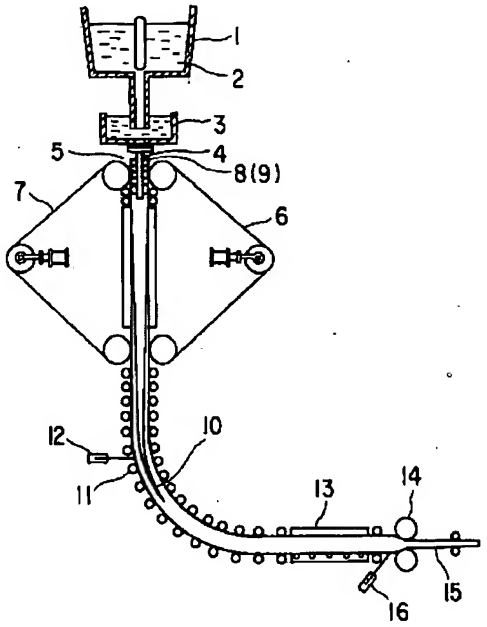
【図２】



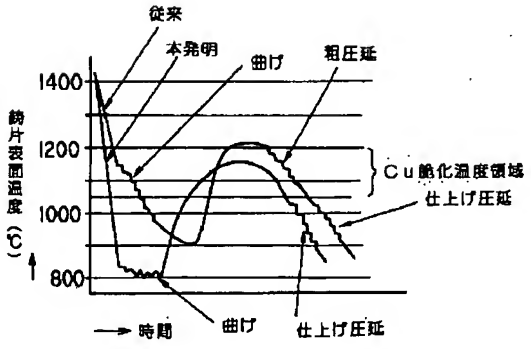
【図3】


鋳板表面割れ発生指数
9
8
7
6
5
4
3
2
1
500
1000
1500
仕上げ圧延機入側での鋳片温度（℃）

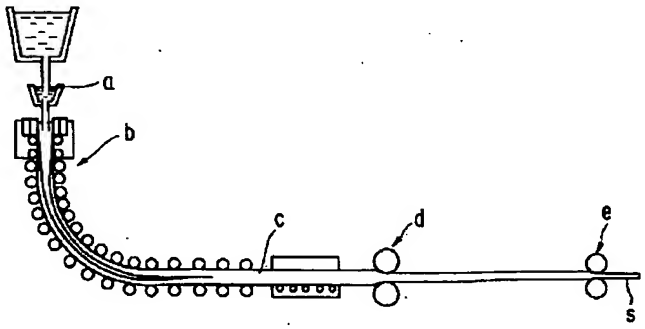
【図4】


1
2
3
4
5
8(9)
6
7
10
11
12
13
14
15
16

【図5】


従来
本発明
曲げ
粗圧延
1400
1200
1000
800
鋳片表面温度（℃）
Cu脆化温度領域
仕上げ圧延
時間
曲げ
仕上げ圧延

【図6】



JAPANESE [JP,07-265908,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

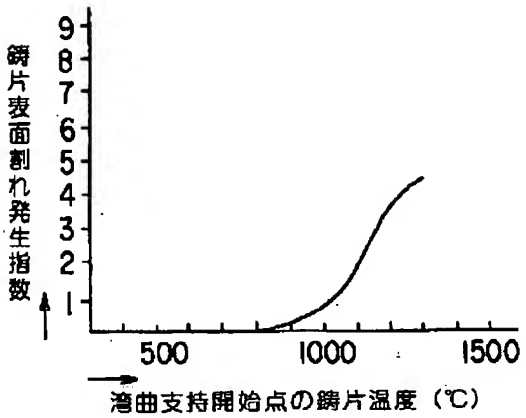
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The thickness contained Sn:0.05% or less faces casting the thin slab of Cu 75mm or less and Sn content steel by the continuous casting approach 0.05 to 0.5%, and it sets in a mold lower part. Cu: -- Cu, the manufacture approach of an Sn content thin slab cast piece which control the cast piece skin temperature in the start point of this curve support at 1050 degrees C or less, and are characterized by controlling generating of the cast piece surface crack resulting from Cu and Sn when carrying out curve support and taking out a casting cast piece.
[Claim 2] Cu, the manufacture approach of Sn content steel plate which are characterized by controlling generating of the steel plate surface crack which faces carrying out heat finishing rolling of the thin slab cast piece obtained by claim 1, and manufacturing a steel plate, controls the cast piece skin temperature by the side of entering to this finishing mill at 1050 degrees C or less, and originates in Cu and Sn.

[Translation done.]

Drawing selection Representative drawing



[Translation done.]

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3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the manufacture approach of Cu, Cu which can control generating of the surface crack resulting from Sn, an Sn content thin slab cast piece and Cu, and Sn content steel plate.
[0002]
[Description of the Prior Art] In the field of steel refinement, it is in the inclination for a scrap to be used so much as a steel raw material, and an opportunity to use the scrap containing Cu(s), such as an automobile, household electric appliances, and a can, and Sn is increasing in recent years. Although Cu and Sn may be made to contain as a positive component depending on a steel type, in the case of common carbon steel, it becomes the component which checks the property demanded in many cases. A small crack crack occurring on a front face, if the content of Cu becomes 0.1% or more, and being proportional to the increment in Cu content, and increasing further is known also by the publication of the Seibundo issue of "effect of alloy element exerted on steel" 378 page.
[0003] Since it is difficult to remove this Cu and Sn by refinement, when refining such a steel type, the scrap containing Cu and Sn and the scrap which does not contain Cu and Sn are mixed, and, therefore, processing which mitigates the effect of these components is also performed for diluting Cu and Sn content (refer to "Eliott Sympisium 1990 Proceedings" 599 pages).
[0004] Moreover, preventing generating of a surface check is proposed by doing said weight % addition of nickel with Cu content on the occasion of refinement of Cu content steel, and controlling a deposit in the steel front face of the melt of Cu at the time of the high temperature oxidation leading to a surface crack to the above-mentioned phenomenon in Cu content steel. However, by this approach, in order to use expensive scarce nickel for a resource, in becoming cost quantity and containing Sn other than Cu, the surface check generating prevention effectiveness by addition of nickel is not notably discovered.
[0005] Thus, although steel refined and obtained is made into a cast piece, is rolled out and is generally produced commercially by continuous casting In recent years, from viewpoints, such as a process abbreviation and mitigation of heat loss, as shown in drawing 6 The continuous casting in-line hot rolling process of carrying out heat finishing rolling of the molten steel a with the continuous casting machine b by finishing mill between heat e which carries out continuous casting of the slab cast piece c, rough-rolls it out with the in-line hot-rough-rolling machine d, and follows this in it, and manufacturing a steel plate s has come to be adopted.
[0006] Thus, when the carbon steel containing Cu and Su is refined, continuous casting is carried out with the continuous casting machine of a curve mold and a perpendicular bending die and a slab cast piece is manufactured, and when a slab cast piece is hot-rolled with in-line one of continuous casting and a steel plate is manufactured, even if Cu content is less than 0.2% in the product obtained by performing hot working, generating of a surface crack is accepted. When bending and rolling are especially performed in Cu brittle temperature region on the occasion of curve support and rough rolling of a cast piece, generating of a surface crack is remarkable, and it is not rare for a surface crack to

generate the finishing mill between heat in the steel plate pass.
[0007] Recently, development of the high-speed continuous casting approaches, such as special continuous casting, such as congruence drum type continuous casting, congruence belt type continuous casting, and single belt type continuous casting, is progressing, continuous casting of the thin cast piece of 10-75mm thickness is carried out, it omits like a rough roll turner, and the attempt which manufactures a steel plate with a thickness of about 1.5mm with the finishing mill between in-line heat is made. Thus, since the surface check of the cast piece resulting from Cu generated on the occasion of curve support of the aforementioned cast piece when manufacturing a steel plate with heat finishing rolling, and Sn leads to generating of the critical defect of the steel plate obtained by carrying out heat finishing rolling, it has also been the failure of implementation of rolling process ** which omitted the rougher roll turner.
[0008]
[Problem(s) to be Solved by the Invention] When this invention carries out continuous casting of Cu with a thickness of 75mm or less which contains Sn for Cu 0.05% or less 0.05 to 0.5%, and the Sn content thin slab cast piece, and carrying out heat finishing rolling without passing through rough rolling, it can control generating of the surface crack of the product obtained cheaply efficiently, and offers the manufacture approach of Cu and the Sn content thin slab cast piece which can omit like a rough roll turner, and a steel plate.
[0009]
[Means for Solving the Problem] The thickness contained Sn:0.05% or less faces casting the thin slab cast piece of Cu 75mm or less and Sn content steel by the continuous casting approach 0.05 to 0.5%, and it sets in a mold lower part. invention of the first of this invention -- Cu: -- When carrying out curve support and taking out a casting cast piece, cast piece skin temperature in the start point of this curve support is made into 1050 degrees C or less. Cu, Cu characterized by controlling generating of the cast piece surface crack resulting from Sn, the manufacture approach of an Sn content thin slab cast piece, and the second invention It is the manufacture approach of Cu and Sn content steel plate which faces carrying out heat finishing rolling of the thin slab cast piece obtained by claim 1, and manufacturing a steel plate, makes cast piece skin temperature by the side of entering to this finishing mill 1050 degrees C or less, and is characterized by controlling generating of the steel plate surface crack resulting from Cu and Sn.
[0010]
[Function] In this invention, when carrying out hot working (continuous casting, hot rolling) of Cu and Sn content steel which contain Sn for Cu 0.05% or less 0.05 to 0.5%, by controlling the temperature at the time of hot working to predetermined temperature, generating of the surface crack of the product obtained can be controlled cheaply efficiently, and the good Cu content thin slab cast piece and good steel plate of quality can be manufactured.
[0011] Since the cast piece surface check occurred when a curve mold and a perpendicular bending die carried out continuous casting of Cu and Sn content steel which contain Sn for Cu 0.05% or less 0.1 to 0.3% and a cast piece was manufactured, this invention person etc. gazed at the organization of the cast piece which the crack has generated for the phenomenon elucidation. It is as being shown in drawing 1 , and Metals Cu and Sn invade in the solidification structure of a cast piece c in the old austenite grain boundary g, it generates and the result is growing up crack h. If Sn contains here, it will compare, when itis [melt-] easy toize Cu and does not contain Sn, and the invasion phenomenon to said austenite grain boundary will become remarkable. And it became clear that this crack was generated notably [when a casting radius / / near the curve support start point of a cast piece / is 10m or less] etc.
[0012] Since it was such, the melting point of the metal Cu in the case of containing Sn was checked, and the relation of the cast piece skin temperature and surface check generating of a cast piece in the curve support start point of the cast piece to this melting point was investigated. The result is as being shown in drawing 2 , and it has checked that the temperature of a cast piece curve support start point could fall a surface check generating characteristic stably below 1050 degrees C. However, when this temperature becomes low too much, while being unable to carry out curve support of the cast piece with

the optimal curvature but smooth casting operation becoming impossible, it becomes difficult to hot-roll this cast piece by optimal temperature. If these things are taken into consideration, as for the lower limit of this temperature, it is not desirable to make it about 800 degrees C or less.

[0013] Thus, generating of the surface check of a cast piece can be controlled at the time of casting. However, since there was a possibility that a crack may occur also when processing it in a temperature field as for which Cu carries out a remelting solution when hot-rolling the cast piece which controlled the surface check which does in this way and originates in Cu (rolling), in the hot rolling mill of a cast piece, the relation between rolling temperature and surface crack generating of the steel plate after rolling was also investigated collectively. The result is as drawing 3 and has checked that the cast piece skin temperature by the side of entering to a hot rolling mill could control surface check generating stably below 1050 degrees C. However, if this temperature becomes low too much, it will become difficult to hot-roll a cast piece by optimal temperature. If these things are taken into consideration, the lower limit of this cast piece temperature of making it about 800 degrees C or less is not desirable. This invention is explained with the example of operation equipment below.

[0014]

[Example] This example is the thing at the time of having carried out continuous casting of the molten steel containing Cu:0.2% and Sn:0.05% with the congruence belt type continuous casting machine (curve mold), manufacturing the thin slab cast piece whose thickness is 50-75mm, carrying out heat finishing rolling of this thin slab cast piece with the finishing mill between heat with in-line one of continuous casting, and manufacturing a steel plate with a thickness of 1.5mm refined and obtained with the converter.

[0015] Drawing 4 is the explanatory view showing the outline of the equipment arrangement in this example. In this drawing, 1 is constituted [molten steel and 3 / tundish and 4] for a molten steel pan and 2 by the slip blocks 8 and 9 of the pair which a submerged nozzle and 5 equipped with the cooling structure which moves in the shape of endless in contact with the both-sides edge inside of the belts 6 and 7 of a pair which move in the shape of [which is mold and was equipped with cooling structure] endless, and the belt of this pair. The thin slab cast piece which 10 cools molten steel 2 with mold 5, and is obtained, and 11 carry out curve support of the thin slab cast piece, and the support roll to take out and 12 are thermometry equipment which measures the temperature of the curve support start point of a thin slab cast piece. Moreover, the steel plate which 13 hot-rolls a heat retaining furnace, and the finishing mill between in-line heat and 15 hot-roll 14, and is obtained, and 16 are the thermometers which measure the temperature of the thin slab cast piece by the side of entering a hot rolling mill, and 17 is a conveyance roll.

[0016] Thus, poured molten steel into the mold of the constituted continuous casting machine, it was made to cool and solidify this, the thin slab cast piece with a thickness of 50-75mm was cast, this thin slab cast piece was hot-rolled with the continuous casting in-line finishing mill between heat, and the steel plate with a thickness of 1.5mm was manufactured. Skin temperature change in each process of a coming [out of the mold in this example] cast piece is shown in drawing 5 with the case of said conventional example (example of drawing 6).

[0017] In addition, the casting conditions in this example and the rolled bar affair are as follows.

"Casting conditions"

Casting steel type: A component presentation is shown in Table 1 with low-carbon steel.

Thin slab cast-piece size: The thickness of 50-75mm, the location of a width-of-face 1300mm casting rate:5 m/min basic casting radius:10m curve support start point:meniscus to 3500mm "a rolled bar affair"

Steel-plate (product) size: Thickness of 1.5mm, width of face of 1300mm [0018] In this example of this invention, when carrying out continuous casting of the thin slab cast piece on the above-mentioned casting conditions, skin temperature in the curve support start point of the thin slab cast piece of the cast piece from mold was made into 1050 degrees C or less, skin temperature by the side of entering to the finishing mill between heat of this thin slab cast piece was made into 1050 degrees C or less, heat finishing rolling was carried out and the steel plate was manufactured. The result is shown in Table 2

with the case of the example of a comparison of this invention out of range, and the conventional example.

[0019]

[Table 1]

	C	Si	Mn	Cu	Sn	P	S	Fe不純物
低炭素鋼	0.05	0.01	0.03	0.20	0.05	0.01	0.008	残り

[0020]

[Table 2]

No.	鋳片厚(mm)	湾曲支持開始点の鋳片温度(℃)	鋳造後の鋳片割れ	粗圧延機入側鋳片温度(℃)	粗圧延後の鋳片割れ	仕上圧延機入側鋳片温度(℃)	仕上圧延後の鋳片割れ
1	75	900	無	−	−	1000	無
2	50	950	〃	−	−	970	〃
3	75	900	〃	−	−	1080	有
4	50	1100	有	−	−	1020	〃
5	50	1200	〃	−	−	1100	〃
6	250	1250	〃	1240	有	1100	〃
7	75	−	無	−	−	1000	無
8	50	−	〃	−	−	1200	有
9	50	−	有	−	−	1000	〃
10	75	−	〃	−	−	1230	〃

[0021] Generating of a surface check to which the thin slab cast piece cast and obtained by this table 2 in Examples 1-2 which are the range of this invention so that clearly, and the steel plate obtained by carrying out heat finishing rolling affect quality was not accepted. However, although the thin slab cast piece which makes temperature of a curve support start point 1050 degrees C or less, casts it, and does not have a surface check was obtained in Example 3 In the steel plate which made skin temperature of the thin slab cast piece by the side of entering the finishing mill between heat 1050 degrees C or more, hot-rolled, and was obtained, this Remarkable crack generating to which quality is reduced was accepted (it is divided into the steel plate which will be obtained if a thin cast piece without a surface check also makes temperature by the side of entering to the finishing mill between heat 1050 degrees C or more and rolls it out, and there is generating.). .

[0022] Moreover, although skin temperature of the thin slab cast piece by the side of entering the finishing mill between heat is made into 1050 degrees C or less as it is and heat finishing rolling of the thin slab cast piece which makes temperature of a curve support start point 1050 degrees C or more, casts it, and has a surface check is carried out in Example 4 Remarkable crack generating to which quality is reduced was accepted in the obtained steel plate (in a thin cast piece with a surface check, it is divided into the steel plate obtained even if it makes skin temperature by the side of entering to the finishing mill between heat into 1050 degrees C or less and rolls it out, and there is generating.). . Furthermore, although skin temperature by the side of entering the finishing mill between heat was made

into 1050 degrees C or more as it was and heat finishing rolling of the thin slab cast piece with the surface check which made temperature of a curve support start point 1050 degrees C or more, cast, and was obtained was carried out in Example 5, remarkable crack generating to which quality is reduced with a natural thing was accepted in the obtained steel plate.

[0023] And it is what made temperature of a curve support start point 1050 degrees C or more, cast the thick slab cast piece in the conventional example 6, rolled out the slab cast piece with a surface check with the hot-rough-rolling machine and the finishing mill between heat as it was, manufactured the steel plate, and made each temperature by the side of each entering a hot rolling mill 1050 degrees C or more, and crack generating was accepted in the obtained steel plate. Example 7 manufactured the thin slab cast piece without a crack by continuous casting, it was a thing at the time of reheating and carrying out finishing rolling with a heating furnace in another Rhine, and crack generating was not accepted, when temperature of the thin slab cast piece by the side of entering a finishing mill was made into 1050 degrees C or less and having been rolled out.

[0024] Example 8 manufactured the thin slab cast piece without a crack by continuous casting, it was a thing at the time of reheating and carrying out finishing rolling with a heating furnace in another Rhine, and crack generating was accepted, when temperature of the thin slab cast piece by the side of entering a finishing mill was made into 1050 degrees C or more and having been rolled out. Example 9 manufactured the thin slab cast piece which has a crack by continuous casting, it was a thing at the time of reheating and carrying out finishing rolling with a heating furnace in another Rhine, and crack generating was accepted, even if it made temperature of the thin slab cast piece by the side of entering a finishing mill into 1050 degrees C or less and having been rolled out.

[0025] Example 10 manufactured the thin slab cast piece which has a crack by continuous casting, it was a thing at the time of reheating and carrying out finishing rolling with a heating furnace in another Rhine, and crack generating was accepted, when temperature of the thin slab cast piece by the side of entering a finishing mill was made into 1050 degrees C or more and having been rolled out. In addition, it is difficult to carry out heat finishing rolling and to obtain the steel plate of thickness the level of 1.5mm in the case where thickness is a slab cast piece 75mm or more, without passing through rough rolling.

[0026] As stated above, when casting a thin slab cast piece with a thickness of 75mm or less for the steel containing Cu and Sn in the continuous casting machine of a curve mold and a perpendicular bending die, a thin slab cast piece with good quality without crack generating can be stably obtained by making temperature of the thin slab cast piece of a curve support start point into 1050 degrees C or less. Moreover, when heat finishing rolling of the thin slab cast piece which was obtained by doing in this way and which breaks and does not have generating is carried out and thickness manufactures the steel plate to 1.5mm level, the good steel plate of quality without crack generating can be stably obtained by making temperature of the thin slab cast piece by the side of entering to the finishing mill between heat into 1050 degrees C or less. In addition, although this invention is adopted in the continuous casting in-line heat finishing rolling process in the above-mentioned example, this invention can be adopted also when carrying out independently continuous casting of a thin slab cast piece, and heat finishing rolling.

[0027]

[Effect of the Invention] In this invention, when carrying out continuous casting of the Cu content thin slab cast piece with a thickness of 75mm or less which contains Sn for Cu 0.05% or less 0.05 to 0.5%, and carrying out direct heat finishing rolling at the time of rolling without passing through rough rolling, generating of the surface crack of the product obtained can be controlled cheaply efficiently, and the good Cu content thin slab cast piece and good steel plate of quality can be manufactured.

[Translation done.]